The British Carbon Group

SPECIAL EDITION NEWSLETTER **SEPTEMBER 2022**

CARBON 2022 – The World Carbon Conference SPECIAL EDITION

ROYAL SOCIETY OF CHEMISTRY

IOP Institute of Physics

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Editorial

Samantha Wilkinson, Communications and New Media Officer of the British Carbon Group

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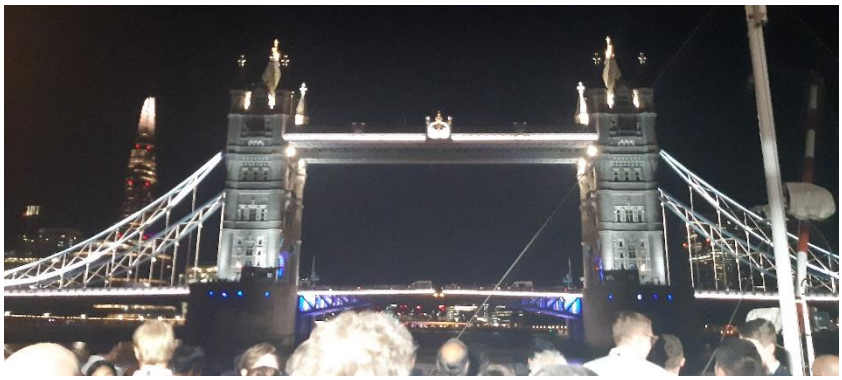
It has been over two years since the last newsletter. You can probably guess from this special edition that this was due to the committee organising Carbon 2022 – the World Carbon conference.

https://carbon2022.org

It was held this summer at Imperial College London with over 300 academics and industry figures from around the world presenting their research over 5 days. Post pandemic it was refreshing to see people in-person and we took advantage of this with the conference social events.

For once the weather didn't let us down and defied all odds to be hot and sunny the whole week of the conference. This made the reception drinks at the SCI headquarters in Belgravia Square into a glorious garden party, and a stunning evening cruise on the river Thames for the conference banquet. My personal highlight was Tower Bridge opening for the dinner boat to pass underneath – a real once in a lifetime experience!



This newsletter chronicles the highlights of the conference, upcoming events, and some featured articles. If you have ideas of what you would like to see in the next newsletter, please get in touch and if anyone has photos or stories from the Carbon 2022, please send them in or share them with us on Twitter (@BCarbonG). I would also like to take the time to thank all the sponsors of Carbon 2022, without their support it would not have been viable to run the conference:

IOP Institute of Physics · Royal Society of Chemistry · SCI where science meets business · Elsevier · attonuclei custom quantum dots · Journal of Carbon Research · Hiden Isochema · Verder scientific · Advanced Material Development · Alvatek · National Nuclear Laboratory · Ingevity · BioLogic Science Instruments · Beilstein Journal of Nanotechnology · Horiba · Surface Measurement Systems World Leader in Sorption Science

BCG Committee News

Notice of 2023 Annual General Meeting

Notice is hereby given that the 2023 Annual General Meeting of the British Carbon Group will be held during the meeting *Energy futures – the role of carbon* at the Society for Chemical Industry, Belgrave Square, London on 1st March 2023. More details of the event will be sent out in due course.

The business of the Meeting is as follows: -

1. Apologies for Absence
2. Minutes of the last AGM (Held at the University of Sussex, June 12th, 2019) on British Carbon Group website (https://www.britishcarbon.org) [Subsequent AGMs were not held because of the Covid pandemic]
3. Chairman's Report
4. Treasurer's Report
5. To Receive Notice of the Representatives of the Sponsoring Bodies
6. Election of Officers and committee members.
7. Any Other Business

At the 2023 AGM the Secretary will stand down, having exceeded his term of office. The Chairman and Treasurer are required to stand down but are eligible for re-election. Nominations for these positions are invited. In addition, three positions of ordinary Committee members fall vacant this year and nominations for these are also invited.

Nominations duly proposed and seconded and with the consent of the nominee, should be received by the Honorary Secretary no later than one week before the AGM by emailing pcminshall@gmail.com

Congratulations to the Winners!

Throughout Carbon 2023 multiple prestigious awards were presented to winners from around the globe. We would like to again congratulate the winners and all those involved in the judging process.

Royal Society of Chemistry Award for Best Poster Presentation at Carbon 2023
Dimitrios Giannakoudakis, University of Thessoloniki, Greece
Biomass derived activated nanoporous carbons for deep desulphurisation of mixed model fuels

AttoNuclei Prize for Nanodots and Biomedicine research presented
Ashley Evans, University of Surrey
Polymeric photonic crystal-based colorimetric devices for sensing applications

British carbon Group Brian Kelly Award
Dr Jacob Martin, Curtin University
(See featured article later in the newsletter)

European Carbon Association Award
Marc Monthioux, CNRS Research Director, CEMES Toulouse, Centre d'Élaboration de Matériaux et d'Etudes Structurales
"The existence and role of a liquid phase in CVD deposition mechanisms of pyrolytic carbons"

Polish Carbon Society Award
Miss Karolina Kordek-Khalil, Wrocław University of Science and Technology
Excellent performance of nitrogen-doped carbon nanofibres as metal-free bifunctional electrocatalysts for water splitting reactions

French SFEC Awards (Société Français des Etudes de Carbone)
Dr Jimena Castro-Gutiérrez, CNRS Université de Lorraine
Molecular sieving of linear and branched C6 alkanes by tannin-derived mesoporous carbons
Mr. Vladimir Pimonov, University of Montreal
Growth kinetics of individual carbon nanotubes studied by in-situ optical microscopy
Dr Emmanuel Picheau, NIMS, Japan
Thermal Oxidation of Carbonaceous Nanomaterials Revisited: Evidence of Mechanism Changes

Carbon ‘22 (nee ‘21), Malcolm, Molly & the Monolith

Geoff Fowler, Chair of the British Carbon Group and the European Carbon Association

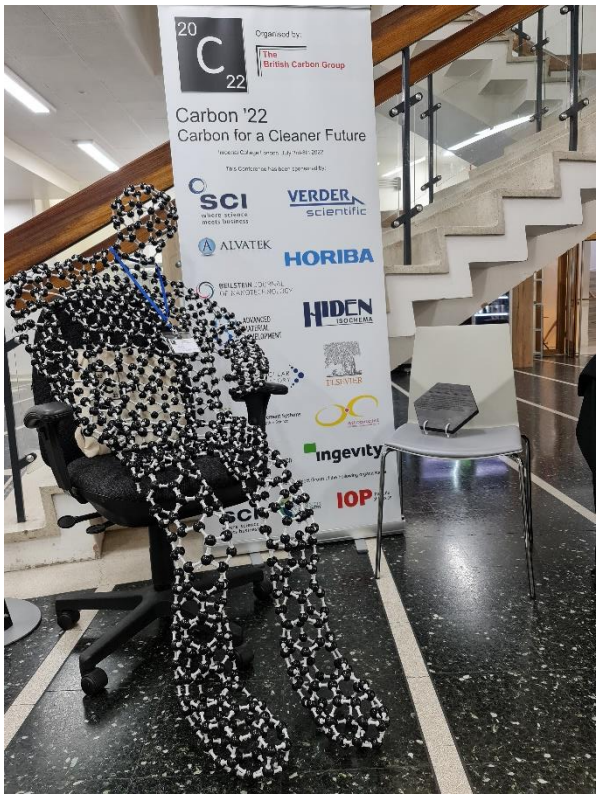
As you will all know by now, Carbon ‘22 (nee ‘21), occurred in July, finally. Its gestation period was longer than an Elephant’s and the “labour pains” significant. When the British Carbon Group volunteered to organise and host the World Carbon Conference in 2021, it was mid-2016 and the world and committee were in a happier place. Things took a severe turn for the worse when in the Summer of 2017, Group Chairman Prof Malcolm Heggie, was diagnosed with a stage 4 brain tumour. Malcolm had to step back and pass over the group reins. They fell into my hands as Vice Chairman. Group activities continued alongside planning for 2021. Tragically, Malcom lost his fight against the tumour and passed away in January 2019, a tragic loss.

The Group had to continue planning for Carbon ’21 and the location, Imperial College London, was confirmed by the committee. An external conference management team were appointed, and the pre-conference notification circulated at Kentucky in 2019. Then 2020 happened and everything changed. COVID hit in March and Japan cancelled Carbon ‘20 at Easter. Multiple, emergency Zoom meetings ensued and the future of Carbon ’21 was decided. The Mexican Carbon Group saved the day by agreeing to postpone Carbon ’22 by 12 months and with further agreement from the World Carbon community, Carbon ’21 became Carbon ’22. The rest is, as you would say, is history, but not quite.

In January 2022, the Japan Carbon Group communicated that they would be sending me “the Monolith”. I had visions of “2001 – A Space Odyssey”. A week later, TNT delivered a large box which contained the “World Carbon Conference Series Monolith”. This hexagonal piece of graphite is engraved with the names of the host cities for every carbon conference since their establishment in 2000. This was to be displayed at throughout the conference.

I found a company who could engrave the Monolith, so another hurdle was cleared (see right), and the Monolith had a pride of place throughout the conference on the main stage at Imperial College Great Hall.

The last piece, and perhaps most significant part of the planning was how to acknowledge Malcolm’s legacy to the World’s Carbon community and British Carbon Group. This is where Molly came to the fore. Around 2015, Malcom built his carbon human to show the versatility of the Carbon atom. Using SP2 carbon atoms from Molymod, this carbon human became “Molly”. Molly travelled the world to plenary lectures, notably in America (and interesting conversations with the US Border agency!) and beyond. On Malcom’s passing, Molly was dismantled and stored like Lego in boxes at his home. In early 2022, the Committee decided Molly needed to be a VIP at the carbon conference. Chris Ewels contacted Sally, Malcom’s widow, to see if we could host Molly at the conference, only to learn that the component parts were at Loughborough University with Roger Smith’s group. Their plan being that Molly would be reborn and become a permanent exhibit and learning tool for the local museum. We arranged to borrow Molly, so Chris planned a visit to Loughborough to help with the resurrection and transport Molly to London. Unfortunately, rebuilding Molly was no easy task, but thanks to Chris’s store of images of Malcolm and Molly, along with a bit of judicious “inventive” chemistry in relation to carbon bonding, Chris and I managed to achieve the miracle and Molly was reborn.



Molly is currently sitting in my office at Imperial, waiting to be returned to Loughborough University. What was evident is that Molly has not lost its charm and made a big impression with the delegates, if the number of selfies taken was anything to go by.

It reassured us that Malcom's Legacy was safe.

Carbon 2022 Student Experience

Negar Mansouriboroujeni, University of Sheffield

Carbon 2022 was my first ever conference, and to be honest I did not have any expectation of what an in-person conference would be like. Having started my PhD journey during a very strict lockdown, C2022, being held in Imperial collage London, defiantly made an impression on me.

I was able to present my work so far, not only that, I was able to present on the first day of the conference, which certainly boosted my confidence. I felt honoured to have been in the presence of so many fascinating scientists. I met molly the carbon lady, I met some of the organisers and founders of the British carbon group and was able to hear many interesting talks about what the world is doing with Carbon.

During the conference I met other PhD students from all over the world, and I have been invited to go and visit a few of them in their home countries.

C2022 had given some ideas of what I want to do after my PhD is completed , I also joined the British Carbon Group as well, and I hope to be able to attend many future Carbon conferences.

The most memorable moment of the conference was when I met Sir Kostya Novoselov and had a chance talk about my PhD project with him.

I started my chemistry journey in Manchester, I used to walk pass the Graphene Institute every day on my way to university, and I used to imagine myself one day working with graphene, so I when saw the advisement for my PhD position, I knew it was sign. Applying for my PhD was one of the best decisions I have made in life, and I am very grateful for it .

I took too many pictures during the conference but here are some of my favourites, including some from boat banquet.

Brian Kelly Award Winner

Jacob Martin, Forrest fellow at the Department of Physics & Astronomy, Curtin University

The 2022 World Conference on Carbon was held at Imperial College London in early July. Given the tumultuous time, it felt remarkable to be sitting in the introductory lecture and welcomed by Prof. Geoff Fowler. It was especially remarkable for me as I had travelled on one of the longest flights in the world from Perth to London (17 hours) to be there. Here are some of my thoughts from my great week in London.
The theme for this year's conference was "Carbon for a Cleaner Future", which is an apt theme for a world in need of carbon to rapidly decarbonise. We heard from excellent plenary speakers including Prof. Novoselov on graphene, Prof. Bandosz on the chemical effects within porous carbon, Prof. Conchi Ania on lighting up nanoporous carbons for catalysts, Prof. Marc Monthioux on carbons mimicking water droplets on a spider's web and Prof. Milo Shaffer on assembling scalable nanocarbons! I filled many more pages of notes from other excellent speakers and presenters throughout the conference.
Another highlight was meeting and hearing talks from industrial scientists at the cutting edge of carbon science. It was remarkable to see the work on reducing the power and degradation of graphite furnaces from Dr Timm Ohnweiler at Carbolite furnaces.
I was very grateful to receive the Brian Kelly Award from Prof. Fowler at the beginning of the conference. The work for which I was awarded the prize is close to that of Prof. Kelly's. In 1981, he wrote,
"The material presented shows that graphitisation is not a simple process, and it is not well understood." Brian Kelly, *Physics of Graphite*, 1981

Here is the personal story of the discussions and collaborations from past Carbon conferences that led to the work I presented in London. In 2017, at the Melbourne Carbon Conference, I met Dr Nigel Marks, Dr Irene Suarez-Martinez and Dr Carla de Tomas from the Carbon Group at Curtin University in Perth, Australia. I was in the middle of my PhD on soot/carbon black formation at the University of Cambridge but became fascinated by the disordered carbon structures the Carbon Group had prepared using molecular dynamics simulations that were able to capture all of the features in glassy and porous carbons. I visited Perth briefly and started to work on these structures with the group, employing some novel visualisation approaches of 3D printing and analysing the structures using a mesh. We managed to find a common nanostructure between the glassy and porous carbons. These disordered carbons also contained an excess of saddle-shaped (net-negative Gaussian) curvature [Martin, Jacob W., et al. "Topology of disordered 3D graphene networks." Physical Review Letters 123.11 (2019): 116105.]. The stacking order in the glassy carbon could then be explained by the sheets winding up to form screw-like defects that enabled a fullerene-like structure to be stacked in particular regions. This

Dr Irene Suarez-Martinez and Mr Jason Fogg operating the GBC graphite tube furnace.

provided a potential explanation for the transition from porous carbon to impervious glassy carbon as well as the isotropic properties of the material.

I presented this work at the 2019 Carbon Conference in Lexington, USA and was very happy to receive the student prize for the talk. It was the SFEC French Carbon Award talk that drew my attention to graphite. Dr Philippe Ouzilleau spoke about the formation of graphite through a thermodynamic model that was done with Prof. Marc Monthioux and others [Ouzilleau, Philippe, et al. "Why some carbons may or may not graphitize? The point of view of thermodynamics." Carbon 149 (2019): 419-435.]. They firstly showed that graphitisation is a second-order phase transition with a critical temperature around Tc=2550 K. Secondly, they suggested the presence of annealable topological defects in graphite that give rise to the phase transition while in non-graphitising carbons other non-annealable topological defects are present that are unable to be removed.

Carbon Group at Curtin University (Ms Kate Putman, Mr Jason Fogg, Dr Irene Suarez-Martinez, Dr Jacob Martin, Dr Nigel Marks)

In 2020 I was able to join the Carbon Group at Curtin University through a Forrest Fellowship. I began working with Jason Fogg and Kate Putman, both PhD students in the Carbon Group. They had been developing a novel, low-cost approach to heat up carbon to 3000 °C using the furnace in an atomic absorption spectrometer (AAS) [Putman, K. J., et al. "Pulsed thermal treatment of carbon up to 3000° C using an atomic absorption spectrometer." Carbon 135 (2018): 157-163.]. This approach had been discovered by Dr Peter Harris, who had previously asked a colleague in chemistry to use these furnaces to prepare samples for electron microscopy.

The Atomic Absorption Spectrometer (AAS) was invented in Australia by Alan Walsh at CSIRO in the 1950s. It works by vaporising metals that then absorb light and it is often used for environmental metal tests such as detecting lead contamination. Vaporisation was originally achieved in a flame, however, a small graphite tube furnace has mainly replaced the flame. This small joule heated graphite furnace has been extensively developed since the 1960s to ramp up extremely rapidly (~3000 °C/s) and have power control to reproducibly control the temperature. Both time and temperature are critical to control for reproducible measurements. These ramp rates far exceed those for conventional graphite furnaces, which require at least an hour to reach >2500 °C. Given the precise control over the time and temperature, it was the perfect instrument to study graphitisation kinetics and so the Carbon Group worked with GBC Scientific, one of the original Australian companies to commercialise the AAS, to have a custom tube furnace provided. This new furnace provided a means to address the problem posed by Prof. Brian Kelly in 1981 for studying graphite:
"The proper study of the variation of a property (of graphite) with time at temperature is difficult because of the necessity to raise the specimen temperature rapidly to very high levels, and the difficulties associated with very high temperature measurements." Brian Kelly, Physics of Graphite, 1981.
When I arrived in Perth, I suggested we look at a graphitising carbon and search for an annealable topological defect. Jason prepared samples across the graphitisation transition with varying residence times by applying

multiple thermal pulses. I then took the samples to the transmission electron microscope for imaging. This new microscope had a cold field emission gun that provided atomic resolution of the graphite and clearly resolved the interplanar defects as screw dislocations that were removed with heat treatment. To find out how the screws form and are removed we performed molecular dynamics simulations to find the mechanism for their removal. There was a nice connection with the screw dislocations, as Dr Suarez-Martinez studied these in her PhD with the late Malcolm Heggie.

We could then probe the kinetics of graphitisation by tracking the crystallites using X-ray diffraction of the pulse heated samples. This revealed that the graphitisation kinetics were more rapid than first thought, occurring on the seconds timescale. The speed at which graphitisation occurs was the aspect that most interested those in the graphite industry at the conference. At 2500 °C, graphitisation takes a few minutes, however, above 2800 °C it takes less than 10 seconds. These insights could have significant cost savings when it comes to industrial production of graphite. Additionally, the removal of screw defects could be targeted to catalyse graphitisation. The preprint for the work is currently online if you would like to read more. A recording of the lecture I gave is also available online.

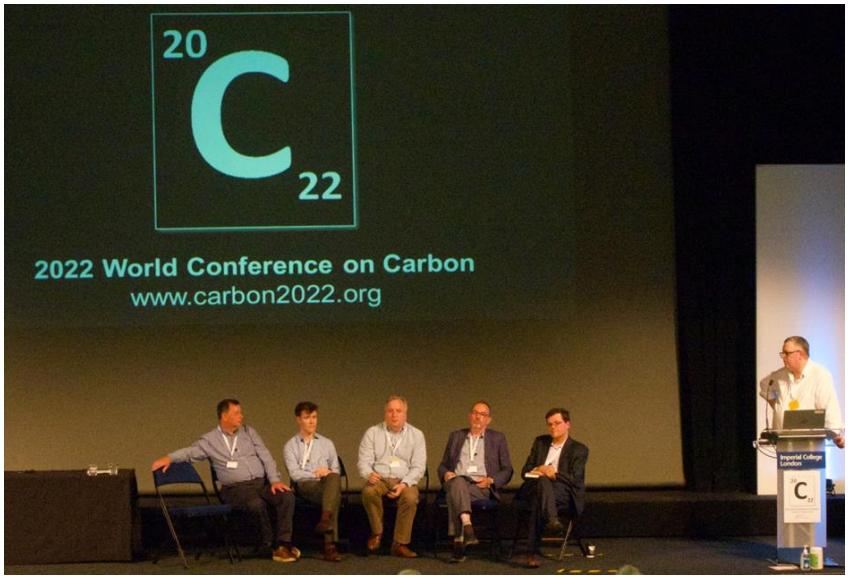
Alongside the presentation on graphite, I gave two other talks on the formation of soot/carbon black (recording available online) and also on the visualisations of carbon nanostructures using VR and 3D printing (recording available online). During the lunch breaks I was able to demonstrate the virtual reality headset and show people carbon in 3D. It was a lot of fun to see people explore these computational models. We also had the opportunity to view other groups' atomistic structures that were emailed as xyz coordinates, providing a new way to engage with other people's work.

Many people were absent from the conference and were sadly missed. Colleagues from China and Japan could not attend due to travel restrictions in their home countries. There were also instances of scientists unable to attend due to global conflict. Dr Yuriy A. Olkhovyk from Ukraine gave an excellent recorded talk on containment of nuclear graphite at Chernobyl. I hope that these barriers will soon be removed within the Carbon community, and we can all freely meet at future conferences.

However, given the situation it was remarkable what the British Carbon Society achieved despite terrible uncertainty. I wanted to personally thank them for bringing together an excellent conference programme, expertly planned and executed.

Elsevier Sponsored 'Futures Challenges in Carbon Science from Industry' Session

Gareth Neighbour, Carbon 2022 Programme Committee Chair



It was a real pleasure to have chaired the programme committee for Carbon 2022 and help deliver what was a fabulous programme across a range of areas: Environmental Carbon; Nanoscale Carbons; Carbon in Energy; Amorphous Carbons; Carbon in Biology, Medicine & Health; Carbon Fibres & Composites; Graphite; Physicochemical Carbon Properties; Diamond; Innovative Carbons for Sustainability; Heterocarbons and Nuclear Graphite. I leave it to others to describe more about the successful conference, but I did want to pick up on a couple of highlights. In putting together the programme I wanted to look to the future and help identify where some of the challenges might be. This seemed right to me to introduce this into the meeting because the UK has a long history of carbon science and I hope it remains so. Few might remember the history starts with the 'discovery' of plumbago (natural graphite) in Cumbria in 1564 during the reign of Elizabeth I – the word graphite didn't really exist until several centuries later when proposed by Werner and Harsten in 1879. Carbon science in the UK has a long tradition associated with the rich coal fields found in the North of England and through this led to many achievements including Rosalind Franklin's very influential work on graphitizing and non-graphitizing carbons. Certainly, the familiarity with industrial carbon materials influenced the UK's decision to focus on graphite-moderated civil nuclear power since the 1940s. This era of the Advanced Gas-cooled fleet of nuclear electricity generation is coming to an end which creates new challenges. So what might come next? Indeed, the UK has had a long association with industrial carbons, from major production of anode carbons in Sheffield until the 1990s, to modern composites technology especially in sports such as Formula One. So, it seemed appropriate to bring together a collection of 'industrial' colleagues to explore what the future might look like. The idea was supported by Carbon journal and Elsevier and they kindly sponsored the session. The panel members included George Miller (Benchmark Minerals Intelligence), Jim Reed (Chief Graphite Engineer, EDF Energy), Andriy Korchev (Senior Principal Scientist, Cabot Corporation), Peter Harris (University of Bristol) and Andrew Keen (Associate Managing Consultant at CRU). Hopefully this will the first of many such discussions looking at ore to applications in carbon and graphite. It was a real pleasure to lead a panel discussion.

The session was an opportunity to explore the futures challenges in carbon science especially from an industrial context. We wanted to ask where will the hot topics be? And where will the challenges be? It is particularly important at this time with the impact upon our environment to understand the challenges in natural and synthetic graphite materials and the consequence to supply chain in the global demand for applications such as battery technologies and other applications, for example the impact upon EV market, and more traditional market sectors such as refractories, steelmaking, expanded graphite, brake linings, foundry facings, lubricants and nuclear. The session highlighted the impact upon the ability to acquire or synthesise suitable materials, and noted the processing required for high quality materials. The discussion covered a lot of ground and too much to report here, but key points included recognising that the metals industry and other commodities consume over 50 million tonnes of carbon per annum. To decarbonise the metals industry in the future, we helped draw out the need for novel materials and key needs of industry being communicated to academia to help meet the challenge. The question then arose whether synthetic will win over natural materials. Perhaps a question for next time?

Apart from the superb technical sessions, another highlight for me was a conference dinner on the Thames with a unique cruise under Tower Bridge. It was one of those 'once in the lifetime events for many as the bridge drew open and we 'steamed' underneath to many jaws dropping in awe!

Support for Ukraine at Carbon 2022

Sergey Mikhalovsky, Carbon 2022 organising committee

The Organising Committee of the British Carbon Group enthusiastically acknowledged the presentations of the Ukrainian Carbon group at the conference. Due to the war started by the Russian invasion and ravaging their country, the Ukrainian scientists were not able to participate in the conference in person. However, even in such extreme conditions, despite all odds, they courageously continued their work, which was presented in two posters on synthesis and environmental applications of thermally expanded graphite and an oral talk on the disposal of irradiated nuclear graphite. The results of the research carried out at the Institute of Environmental Geochemistry of the National Academy of Sciences of Ukraine were presented on their behalf by the participants from the British Carbon Group with whom they collaborate.

The Organising Committee and the conference participants were also impressed by the number and the quality of presentations from Kazakhstan. The Kazakhstani researchers regularly participate in Carbon conferences, and this time their delegation comprised 17 members, the fifth largest group from a single country. During the conference, the Kazakhstani group revealed their intention to create their own Carbon Group and join the European Association of Carbon groups. The Chairman and other members of the BCG assured the Kazakhstani researchers of their full support of this idea. The BCG already helped the Ukrainian researchers to create their national Carbon Group some years ago, and this year the new Kazakhstani Group will join the carbon community. For those who are not very good in geography and football, please note that the Kazakhstani national team always participates in the European football competitions, and the part of this country which is geographically in Europe is larger than some EU member states. Perhaps it should not be surprising, considering that Kazakhstan is the ninth largest country in the world.

Future Event: International Nuclear Graphite Specialists Meeting 2023

The first face-to-face International Nuclear Graphite Specialists Meeting since Covid will be held in Aachen, Germany, in September 2023 (10th-14th) and will as usual cover all current interests within the entire lifecycle of nuclear graphite internationally. The venue is called Forum-M which is above a massive bookstore (rather like Foyles in Charing Cross Road) with at least three coffee bars. For further information please contact Tony Wickham (confer@globalnet.co.uk).

Future Event: Next Stop “The World Conference on Carbon 2023” in Mexico

Rene Rangel-Mendez, IPICYT Mexico & Chairman of Carbon 2023

First, I want to thank the organizing committee of the World Conference on Carbon 2022, who did an excellent job in organizing this important event, which was a success.
I am especially grateful to Geoff Fowler and Chris Ewels for their assistance and support in promoting our upcoming “Carbon 2023” conference. As some of you are already informed, our congress will take place in Cancun, Riviera Maya, from July 16th to 21st next year, to which you are all cordially invited.
I considered that the promotion of Carbon 2023 started successfully. The organizers of carbon 2022 kindly provided us with a space in the hall where the poster presentations took place and where the sponsors were placed. In this site we gave away more than 250 hand-painted Mexican clay skulls, which were liked by many of the attendees. Of course, we took the opportunity to provide the flyers that included the most important information of our congress. And something even more exciting, we provided tequila shots: in less than 2 hours, 3 L of this Mexican beverage disappeared, with which, I think, the attendees were even more enthusiastic to attend Carbon 2023.

The promotion of our upcoming congress did not end there, because during the conference dinner, we continued talking about it. In addition, we had the opportunity to take some snapshots with two of the main speakers of Carbon 2023 (Magdalena and Alberto), and with colleagues and friends during our tour on the beautiful River Thames.

Finally, on the closing day of Carbon 2022, we were given the opportunity to make a presentation in which we showed the main scientistic topics of our next congress, in addition to the important dates and the names of the speakers already confirmed. We believe that the carbon community is excited to attend the World Conference on Carbon 2023 to which we reiterate our warmest invitation to all of you (https://www.carbon2023.org)

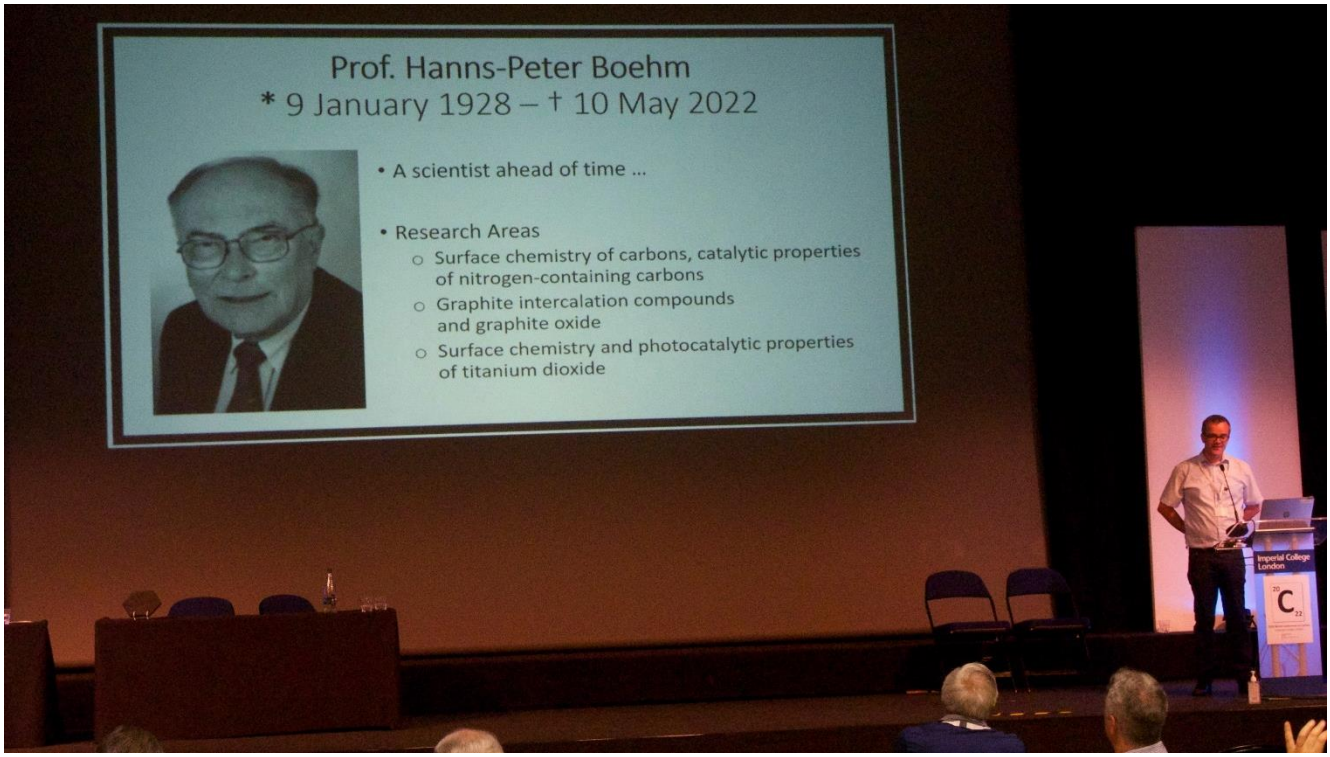
See you in Cancun, Riviera Maya, in July 2023.

Tributes: Francisco Rodríguez-Reinoso, Bob Curl & Hanns-Peter Boehm

The British Carbon Group would like to pay tributes to Bob Curl, Francisco Rodríguez-Reinoso and Hanns-Peter Boehm after their sad passing. Bob Curl (23rd August 1993 – 3rd July 2022) was an American chemist at Rice University and a recipient of the Nobel Prize in Chemistry in 1996 for the discovery of the nanomaterial buckminsterfullerene ("Buckyballs") with Richard Smalley and Harold Kroto. The molecule was named after architect Buckminster Fuller who designed geodesic dome structures that have the same structure. Francisco Rodríguez-Reinoso (1941 – 25th August 2020) was a Spanish chemist and well known in the field of absorption and activated carbons and a Professor emeritus at the University of Alicante.

Peter A. Thrower also paid tribute to Francisco Rodríguez-Reinoso in Carbon N Y: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7572069/

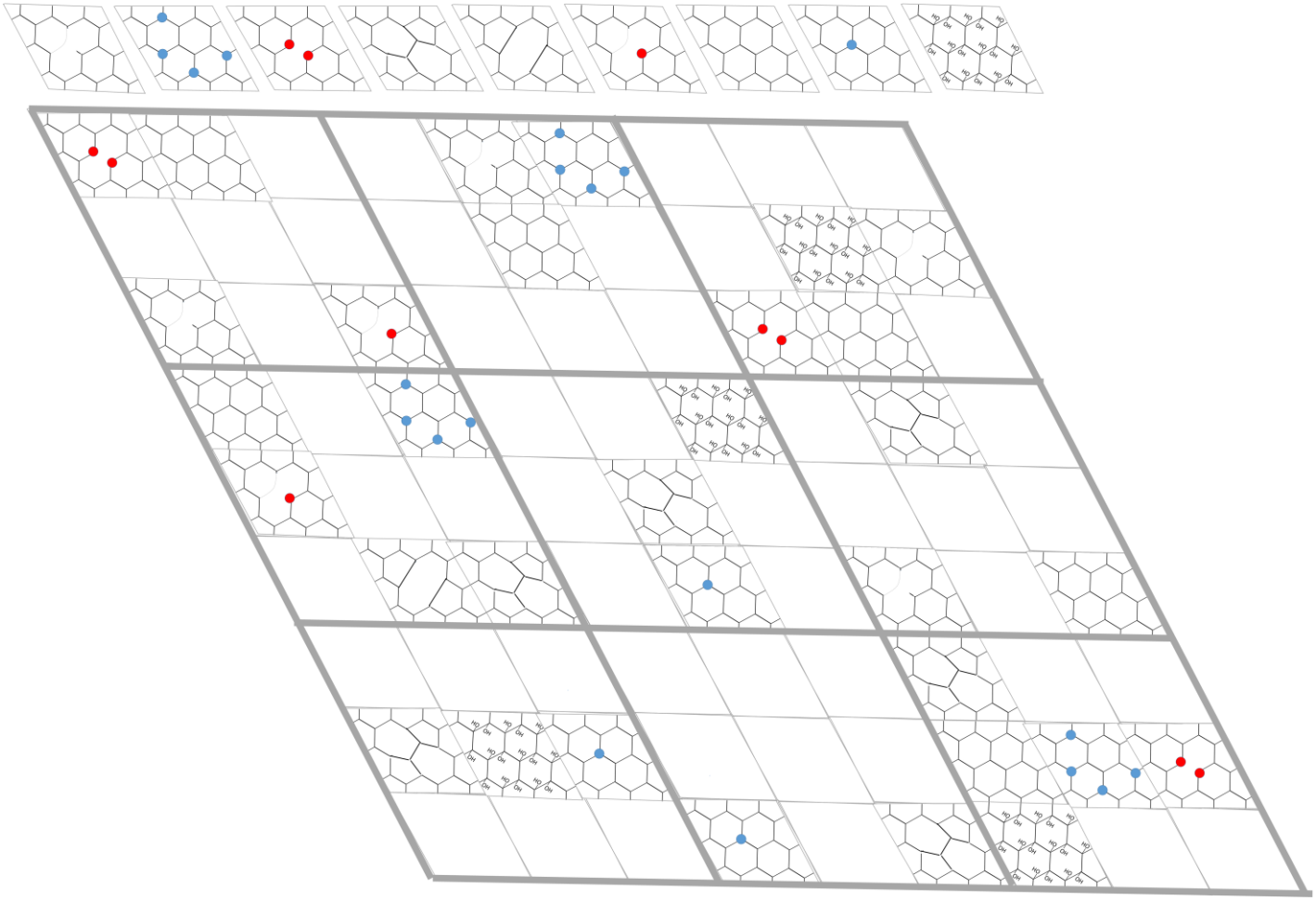
On the final day of Carbon 2022 during the plenary talk session tributes were paid to Hanns-Peter Boehm. He was a German chemist and considered by many to be a pioneer of graphene research.



Puzzle: Defective Graphene Soduko

Chris Ewels, Vice-Chair of the British Carbon Group

Complete the angled grid, with each graphene defect appearing only once in each 3x3 square, each row, and each column. The defect structures shown above the grid are, from left to right, a monovacancy, C3N, oxygenated divacancy, Stone-Thrower-Wales / Deanes / Bond-rotation defect, divacancy, oxygenated monovacancy, pristine graphene, substitutional nitrogen defect, and hydroxylated graphene patch.



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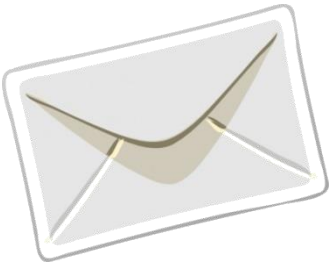

The BCG welcomes feedback from its members, so please get in touch with us if you attended one of our events and it sparked an idea, you have been involved in a particularly interesting project or have any other thoughts which might be of interest to the rest of the group!

Please submit any thoughts to samantha.wilkinson@uknnl.com

Items for the next newsletter – Submit an Article

We'd like to hear what you're doing, what you think of the British Carbon Group, any ideas you may have for networking opportunities or anything else you think would be of interest to the rest of the Group. We plan to publish the next Newsletter in Spring 2023.